

Kaon optical potential at finite temperature*

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Heavy-ion collisions create nuclear matter with high density and temperature. Kaons might be an interesting tool to probe hadrons in matter at these conditions. It has been proposed, that the K^- will change its properties in dense matter considerably [1]. The in-medium mass of the K^- will drop at finite baryon density compared to its vacuum value. Hence, the production of K^- in heavy-ion collision at the threshold will be enhanced compared to the free proton-proton collisions. This has indeed been seen at recent heavy-ion experiments [2].

The dynamics of the kaon-nucleon system is rather complicated due to a resonance lying just below threshold, the $\Lambda(1405)$. This results in a repulsive scattering amplitude. The situation changes in dense nuclear matter. Coupled channel calculations show, that this (repulsive) resonance is shifted away in dense matter due to Pauli-blocking effects. As a consequence, the K^- will feel an overall attractive potential which is about -100 MeV at normal nuclear density [3]. Dynamical simulations of heavy-ion collisions including such an attractive in-medium potential can describe the enhancement seen [4].

However, so far these calculations have ignored effects due to the finite temperature of the system. Hadron spectra indicate, that the matter created in heavy-ion collisions can have temperatures of the order of 80 MeV. We have extended the calculations of [3] to finite temperature. The optical potential, i.e. the decrease of the kaon mass, is shown in the Figure at normal nuclear density as a function of temperature. One sees, that the optical potential turns repulsive at higher temperature. The change of the sign happens already at a temperature of 25 MeV, well below the temperature seen in hadron spectra of an heavy-ion collision.

We have also studied the momentum dependence of the kaon optical potential and found

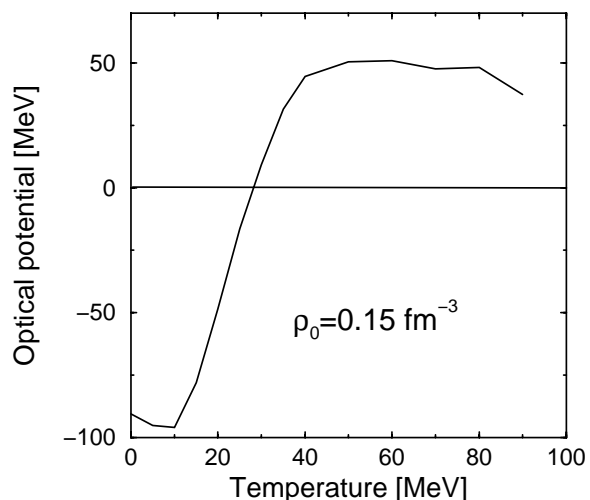


Figure 1: The optical potential of the K^- at normal nuclear density as a function of temperature.

that the potential is less attractive at finite momentum. These effects are in contrast to the enhancement seen in heavy-ion experiments. This indicates that the dynamics of kaon production in heavy-ion collision is presently not very well understood. A possible explanation are rescattering effects: the $\Lambda(1405)$ is destroyed by rescattering with the surrounding nucleons, so that the attractive mean-field potential remains. This is presently under investigation.

References

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* LBNL-41395